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ABSTRACT

The acquisition of verb meaning is discussed and compared with the acquisition of simple noun meaning. Evidence presented from three experiments with children and adults indicates that (1) verbal meanings are relatively slow to be acquired; (2) the acquisition of verb meaning involves the gradual addition of semantic components; and (3) verbs are used by children and adults with greater breadth of application then are simple nouns. These findings are discussed in terms of the kinds of meaning conveyed by nouns and verbs: simple nouns refer to real-world entities and verbs convey relationships among entities. (Author/AA)

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ON RELATIONAL MEANING: THE ACQUISITION OF VERB MEANING

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On Relational Meaning: The Acquisition of Verb Meaning

Acquisition of verb meaning lags behind acquisition of noun meaning by almost every conceivable measure. Verbs are slower to enter the vocabulary than nouns. Chukovsky (1968) cites a typical diary study by William Stern (1851-1938): at 1-3, the child's vocabulary consisted entirely of nouns; at 1-8, 78% nouns and 22% verbs; and at 1-11, 63% nouns, 23% verbs, and 14% adjectives. Three children studied by Huttenlocher (1974) all learned nouns before verbs. In Nelson's (1973) corpus drawn from 18 children, action words comprise only 16% of the first 10 words learned, while nominals comprise 65% (41% general nouns and 24% individual names). Moreover, the proportion of general nouns increases to 62% over the course of the first 50 words (achieved between 15 and 24 months), while the proportion of action words declines slightly to 9%, indicating a much greater rate of increase in the number of general nouns than verbs. Greenfield and Smith (1976), who observed two children from their first one-word utterance until the stage of combining words, found that the earliest clearly linguistic semantic functions were referential uses of nouns, e.g. dada, looking at father, at 7 or 8 months. For both children the earliest relational word was down, occurring at 13 or 14 months of age. The first true verbs, eat and bay (play), entered at 16 and 20 months, respectively. The period between the first noun and the first verb was as long as the period between birth and the first words.

Ervin-Tripp (1971) reports a study by Wick Miller in which children were taught artificial words. Over a period of about a year, the experimenter and a two-year-old child played a game with plastic

beads. The experimenter used the noun po to refer to beads of a particular kind, and the verb to sib to refer to actions of a particular kind. The child first used the noun at age 2-2, after 67 inputs; the verb was not used until 8 months later, after 164 inputs. Finally, in a systematic study of the comprehension and production of two-year-old children, Goldin-Meadow, Seligman and Gelman (1976) found two stages of early vocabulary development. In both stages, about twice as many nouns as verbs were comprehended. In the first stage, about one-third of the comprehended nouns were produced, and no verbs were produced. In the second stage, characterized by longer sentences, almost all nouns comprehended were produced and about one-third of the verbs comprehended were produced. Thus acquisition of verbs lagged behind that of nouns, and moreover the production/comprehension ratio for verbs in the second stage was similar to that for nouns in the first stage.

This difference in rate of acquisition between nouns and verbs is dramatic and persistent. Even some fairly frequent verbs are not fully understood by children of 9 years and older.

The aim of this paper is to give an account of the acquisition of verb meaning, basing the discussion on the premise that there is a fundamental difference between the relational meanings expressed by verbs and the referential meanings expressed by simple nouns. The plan of discussion is first, to present an approach to representation of verb meaning; second, to review two major current theories of acquisition of meaning; and finally, to discuss in some detail the acquisition of verb meaning, in light of the first two sections.

Representation of Verb Meaning

Representations of verb meaning have been proposed by researchers in linguistics (e.g., Bendix, 1966; Chafe, 1970; Fillmore, 1971; Postal, 1970; and Talmy, 1972); artificial intelligence (e.g., Schank, 1973); and psychology (e.g., Abrahamson, 1975; Fillenbaum and Rapoport, 1971; Gentner, 1975; Miller and Johnson-Laird, 1976; Rumelhart and Levin, 1975). All of these systems are componential, in that verb meanings are represented in terms of meaning elements which are smaller or more primitive than words, and propositional, in that semantic relationships are explicitly represented. The particular format used in this paper is a propositional network notation developed by the LNR Research Group at the University of California at San Diego.(2) The elements of the representations are subpredicates which stand for relational concepts (e.g., CAUSE); and labeled pointers which identify the entities to be related (e.g., ->). Most English verbs are represented by a set of several subpredicates with a number of interrelationships. For example, Figure 1 shows that give conveys that an agent performs some unspecified action which causes the possession of an object to change from the agent to someone else. Subpredicates can be related to other subpredicates (e.g., in Figure 1, CAUSE is related to CHANGE by a pointer labeled Result) or they can be related to noun arguments (e.g., DO is related to Ida by a pointer labeled agent).

Insert Figure 1 about here

These subpredicates are not put forward as basic primitive units of thought. On the contrary, it seems likely that some of the components can be further analyzed. Nor is the representation of a given verb exhaustive. Not all logically possible inferences that follow from use of a given verb are represented as subpredicates, but only those which are psychologically extremely probable. Thus, the subpredicates of a verb express the almost-inevitable inferences that are made during comprehension of a sentence containing the verb.

Relational Meaning and Referential Meaning

It is sometimes said that nouns refer to objects and verbs refer to actions. This formulation slights an important distinction between relational and referential meaning. In the linguistic description of a situation, nouns specify the thing-like elements, while verbs and other relational terms specify relations between those elements. (See Talmy, 1972 for a more complete discussion of this issue.) This difference in communicative function leads to differences in both the content and the structure of verb and noun meaning. With respect to content, noun meanings are more concrete than verb meanings. In particular, basic-level concrete nouns (which I will call simple nouns) have the function of pointing to objects in the world. As Rosch (1973, 1975) has demonstrated, their meanings are highly constrained by the nature of the physical world. Verbs, in contrast, express relational meanings which depend on abstract concepts and are relatively unconstrained by the physical world.(3) For example, in the representation shown in Figure 1, no one particular action is associated with the verb give. Instead, give conveys a set of

relationships among the noun arguments. These relationships - such as CAUSE or POSS - are abstractions that depend as much or more on cultural notions of relatedness as on the sensory information actually present. This difference in abstractness is reflected in children's slowness in acquiring verb meaning relative to noun meanings.

The relational-referential distinction is relevant to the structure of meaning representations as well as to the content. A simple noun, with its referential function of pointing to an object, behaves as a unified node for most communicative purposes. The verb must decompose into subpredicates which link with the appropriate nouns in order for normal comprehension of the sentence to have occurred. For example, in Figure 1 the components of give are each related to different parts of the sentence: POSSESSION (initial) relates Ida and rose; DO relates Ida and the causal chain; and so on. This is not the case with rose. The various attributes of rose - the physical parts, the scent, etc. do not enter into separate relations with other parts of the sentence; rather, they act as a unified concept. This need not imply that simple nouns have no componential structure. Featural representations of nouns, including simple nouns, have been proposed (e.g., Katz and Fodor, 1963; Smith, Shoben and Rips, 1974). However, a complete representation of simple noun meaning would have to reflect the fact that the components of simple nouns are both highly interrelated with one another and highly redundant as compared with the components of verbs. The components of verb meanings are more separable from one another than those of noun meaning. Therefore, as we shall explore later, verbs provide some of the clearest examples of componential acquisition of meaning.

We turn now to a description of the two major theories of acquisition of meaning: Clark's (1973) semantic feature hypothesis and Nelson's (1974) functionally based theory.

Two Theories of Acquisition of Meaning

Clark's (1973) semantic feature theory has as its central postulate that word meanings are acquired componentially. This leads to two major predictions: (1) All else being equal, word meanings should be learned in order of semantic complexity, with words that have few components being acquired before words that have many components; and (2) Early errors should be indicative of incomplete semantic representations; words that have many components may be represented in early stages like simpler words with few components. Clark further hypothesized that the information stored in early word meanings is predominantly perceptual. Finally, a subsidiary assumption was that children use words in strict accordance with their meanings. In particular, children's overextensions of early nouns were taken to indicate that the children's meanings lacked some of the semantic features present in the adult meanings.

Nelson's (1974) theory emphasizes functional information. Nelson points out that children are interested in dynamic and functionally relevant aspects of situations, and argues that, at least initially, relational and functional information predominates over perceptual information. A large number of functional relationships are assumed to be present at first, with extraneous and fortuitous relations dropping out later. A final assumption is that the internal structure of the concept is at first holistic, not analytical.

With these theories in mind, we now turn to research on the details of the acquisition of verb meaning, using the representational notions discussed earlier. The material is organized according to whether it bears primarily on the structure, content or use of the meaning representations.

Structure

Componential Acquisition

If the structure of verb meaning is separable into component subpredicates, then we might expect to see evidence of children's gradual accretion of these semantic components, along the lines suggested by Clark (1973).

Verbs of communication. In a pioneering study of children's comprehension of verbs, Chomsky (1969) asked children to act out sentences such as "Donald promises Bozo to jump on the table." She found that the verbs ask and promise were acquired fairly late, at about 7 or 8 years; and that, for both ask and promise, children who made errors acted out the verb as though it were tell. Although Chomsky interpreted these results in terms of acquisition of syntactic rules, Clark (1973) has pointed out that this pattern accords with the predictions of a componential theory of acquisition. The meanings of ask and promise both contain all the components of tell, as well as additional components. Therefore, in the stages before their meanings are fully understood, we would expect just such a partial representation, given componential acquisition of the meanings.

Verbs of possession. Seeking evidence of componential acquisition, I investigated the acquisition of the verbs give, take,

pay, trade, spend, buy, and sell (Gentner, 1975). The verbs were divided into three groups based on semantic complexity: (1) give and take, which require only the components DO, CAUSE, CHANGE and POSS; (2) pay and trade, which require the components of the Group 1 verbs plus, for pay, the component OBLIG (social obligation) and the constraint that the object transferred be money, and for trade, the component CONTR (mutual obligation); and (3) buy, sell and spend, which require all the components of both Group 1 and Group 2. Because the verbs share a great many semantic components, this complexity ordering is quite precise: the representations of the verbs in a given complexity group contain as proper subsets all the components present in the representations of the verbs in all less complex groups. For example, all the components of give (Figure 1) are contained within the representation of sell (Figure 2).

Insert Figure 2 about here

Applying the notion of componential acquisition yields two predictions: (1) verbs should be acquired in order of complexity; and (2) in the period before children have completely acquired the meaning of a given complex verb, their representation of the verb should contain just those components with which they are familiar. Thus the children's representation of the complex verbs will be similar to the representations of simpler verbs.

Seventy children (14 in each of five age groups ranging in age from 3 1/2 to 8 1/2 years) participated. Each child was given two

dolls with toys and money and asked to act out sentences; e.g., "Make Ernie buy a car from Bert." The experimenter recorded the source doll, goal doll, and object(s) for every transfer the child performed. The results support the notion of componential acquisition. The verbs are acquired in the order predicted: Taking 75% correct as the criterion for acquisition, Group 1 is acquired by 3 1/2 years, Group 2 at around 5 1/2 years; and Group 3 at around 8 1/2 years. Further, the pattern of errors for the complex verbs indicates that even young children have acquired the components DO, CAUSE, CHANGE and POSS, and that their representations of complex verbs are based on these components. The most frequent error for buy is for children to act it out as though it meant take: similarly, sell is acted out as give. These errors indicate incomplete representations of buy and sell. The children have acquired enough of the meanings to perform object transfers in the correct direction, but show no awareness of the components OBLIG or CONTR or of the constraint of a money-argument. Similar evidence for an acquisition order from simple meanings to complex meanings has been found for the verbs of motion come, go, bring and take (Clark and Garnica, 1974), and for other kinds of relational terms, notably dimensional adjectives.

Possible Words: Rules for Combining Semantic Components

Bowerman (1974) has observed in her daughters' speech the operation of rules for combining semantic components into words. In one case, a rule concerning the component CAUSE was overgeneralized. After having used non-causal verbs such as fall and stay correctly for some time, Christie at the age of 2 years began to use them causally;

e.g., "I'm just going to fall this on her." The verb fall for adults means something like "CHANGE from LOCATION (high) to LOCATION (low), non-volitionally." Christie used fall transitively, as though it meant "DO something to CAUSE a CHANGE in another object from LOCATION (high) to LOCATION (low). She had never heard the word used with that meaning, but had learned and overgeneralized a common English pattern of word relationships: namely, that the word for a state or for a change of state can often be used to refer to causing the state or change of state to occur; e.g., "The box is open." / "I open the box." To have overgeneralized this rule, the child must not only have had a distinct component for causalty in her representation, but must have been aware at some level of the regularity of the rule for the addition of a CAUSE component.

Overall, the general model of verb meaning as componentially represented and componentially acquired seems quite promising. We next turn to the content of the child's semantic representations.

Content

When children learn word meanings, what kinds of information are included in their representations of meaning? According to Clark (1973), early word meanings contain chiefly perceptual information, which is accessible even to the very young child. Nelson's (1974) position is that early word meanings contain chiefly functional information, since this is of primary interest to the young child. Both theories hold that an object's normal motion is likely to be included in its early meaning. They differ as to the role of the static form of an object and of the use to which an object is put. The Clark theory states that form and not use is prominent in early word meaning; the Nelson theory, that use and not form is prominent.

Experimental Comparisons of Form, Motion and Use

The difficulty in comparing form, motion, and use in early word meanings is that they all tend to be closely correlated in the real world (cf. Anglin, 1977). In this section I describe two experiments in which novel objects were constructed to separate these variables. In one of these, form and use were opposed; in the other, form and motion.

In Experiment 1, the child learned the names jiggy and zimbo for two objects differing from one another in both form and use. Then the child was asked to name a hybrid object which was identical to the jiggy in form and to the zimbo in use, as described in Table 1. If the children's meanings for jiggy and zimbo are based on use, then the name zimbo should be applied to the new object; if form is the basis for the word meanings, then the hybrid should be called a jiggy.

Insert Table 1 about here

There were 53 subjects, ranging in age from 3 years to adulthood, as shown in Table 2. The objects were presented in a naturalistic way. First, the child encountered the jiggy in a waiting room, where s(he) played with it and learned its name. Then, in an experimental room, during other unrelated experiments, the child encountered the zimbo and was encouraged to operate it and to eat the jelly beans dispensed. Not surprisingly, children learned its name very quickly. After a second visit to the waiting room to be sure that the child could remember the jiggy, the child was taken to a third room, shown the

hybrid object, and asked "Can you make this work?" Children were usually astonished when jelly beans poured from what looked like a jiggy. The experimenter then asked "Now what do you suppose this is called?" Most children readily identified the object as either a jiggy or a zimbo. If any other term was used (e.g., a combination term such as jiggy-zimbo, as was common with older children and adults) the experimenter said, "If it had to be either a jiggy or a zimbo, which would it be?" The results are shown in Table 2.

Insert Table 2 about here

The pattern of results is rather surprising. Very young children and adults respond according to form, while intermediate-aged children respond according to use. Exactly what this U-shaped pattern means is not entirely obvious. However, one clear conclusion is that the young children -- 2 1/2 to 4 1/2 years of age -- are applying the words on the basis of static perceptual attributes, and not on the basis of use.

In Experiment 2, form and motion were opposed in the same basic design, applied this time to both nouns and verbs. There were eight subjects in each of the following age groups: 3 to 4 years, 4 to 5, 5 to 6 and adult. Two novel objects were each made to move in a particular motion pattern by means of motors. The objects were approximately alike in size and color but different in shape and in pattern of motion. The experimenter and child looked through a window at the object in motion, and the child learned the name of either the

object (noun condition) or the action (verb condition). In the noun condition, the experimenter would say "There's the wurby. What's it called?" and so on. When the child appeared to know the word, the second object, a geep, was similarly presented in its motion pattern. (Pairing of objects with names was counterbalanced). After the second name was learned, the objects in motion were presented alternately in order to be certain that both names were well learned. Finally, the child was asked to name the crucial test object, which was a combination of the shape of one object (e.g., the wurby) and the motion pattern of the other (e.g., the geep). The procedure followed in the verb condition was identical (with different objects and motions), except that the child was told "That one is bipping (cogging). What is it doing?" As with the nouns, the child learned both verbs and was then tested on a combination object. Then the child was retrained on the original noun objects and shown the alternative test object (e.g., a geep shape having wurby motion). The verb condition was repeated in like fashion. This provided two noun responses and two verb responses from each child. The results are shown in Table 3.

Insert Table 3 about here

The proportion of motion responses is higher at every age for verbs than for nouns. Even at the age of three years, children appear to differentiate to some extent between verbs and nouns. Nonetheless, younger children respond predominantly on the basis of form, though

less so for verbs than for nouns. Motion responses appear to increase with age, but only in adults is there any strong tendency towards motion responses, even for verbs. These surprising results suggest either that young children initially base meanings, even verb meanings, more on perceptual form than on dynamic information, or else that these children believed that bipping and cogging were names for objects in spite of the syntactic evidence to the contrary. Whichever interpretation is correct, it seems that the children more readily formed meaning representations based on form than representation based on motion.

The results of Experiment 2 indicate predominance of form over motion; those of Experiment 1 indicate predominance of form over use. Taken together, these results suggest that young children are likely initially to include in their word meanings static information about how objects look, rather than informati n about how they move or what they are used for. These results are in accord with Bowerman's (1975) analysis of her children's errors in noun usage during the one-word stage. There were many errors based on perceptual similarity, particularly similarity of shape, in the absence of functional similarity; but there were hardly any errors based on functional similarity in the absence of perceptual similarity.

It appears, then, that static perceptual information is more likely to appear in early word meaning than either dynamic perceptual information (motion) or information concerning use. The obvious next comparison is motion versus use. A natural comparison exists here in the acquisition of verbs which convey information on both motion and use.

Mixing: Function versus action. Many English verbs convey both an action and a change of state resulting from the action. This change of state is the normal purpose or result (or use) of the action and constitutes the functional aspect of the verb's meaning. In order to compare acquisition of functional meaning and action meaning, I examined children's comprehension of the verbs mix, stir, beat and shake. Mix, stir and beat (by hand) evoke roughly similar scenarios with similar instruments, but differ in the degree to which they specify particular actions versus particular functions. The verb mix is strongly functional; mix specifies a change of state (an increase in homogeneity) and is unspecific as to the actions that result in this change. In contrast, stir specifies a certain kind of hand-and-spoon-motion (rotary medium-slow) and leaves the function unspecified. Figure 3 shows tentative representations of the meanings of mix and stir, developed by James Greeno and me. Beat (by hand) specifies a rapid, more-or-less elliptical motion and has a weak functional specification of change-of-texture. Shake, though not primarily a mixing-verb, is similar to stir and beat in specifying a certain kind of motion and placing few if any constraints on the function of that motion.

Insert Figure 3 about here

In Experiment 3, subjects aged 5 to 7 years, 7 to 9 years and adult (8 subjects per group) were asked to label various events. The experimenter performed actions of stirring, beating or shaking, using

mixable or nonmixable substances in glass bowls or jars. The mixable substance was a combination of salt and water, the homogeneity of which was increased by any of these actions. Cream was used as the nonmixable substance; its homogeneity was unchanged by any of the actions. There were six combinations of the two substances with the three actions, as well as other events not relevant here. After a first pass in which the child labeled each of the events as the experimenter performed them, the experimenter repeated each event, asking specific questions, e.g. "Am I beating it? Am I mixing it?" For each event the child was asked to verify beating, stirring, mixing, and shaking, as well as filler verbs, e.g., singing. Assuming that our representations of the verb meanings are correct, an ideal speaker should agree to the use of stir, beat or shake when and only when the corresponding action was performed (i.e., for one-third of the events); and should agree to the use of mix when and only when the substance acted on was mixable (i.e., for half of the events). Each event was tested twice, in random order. The results of the verification task are shown in Table 4.

Insert Table 4 about here

The results indicate that, for the verb mix, understanding of action meaning precedes understanding of function meaning. All age groups distinguished appropriate from inappropriate actions in their uses of stir, beat and shake. That is, they were more likely to agree to a word's use when the action was correct than when it was not.

However the youngest children -- aged 5 to 7 -- did not distinguish appropriate from inappropriate changes of state in their uses of mix. Older children and adults did make this distinction, applying mix more often to actions performed on salt and water than to actions performed on cream. Thus it appears that knowledge of the action components of stir, beat and shake precedes knowledge of the proper change of state (the functional meaning) of mix.

This is not to say that the functional aspects of the act of mixing are uninteresting to children. On the contrary, young children take great interest in successfully mixing paints, foods, mudpies and so on. Indeed, in other experiments I have found that the verb mix is understood as an action verb very early (by about 3 1/2 years). Similarly, in Experiment 1 it was informally observed that the name zimbo, for the jelly-bean machine, was learned more quickly than the name jiggy, for the toy that merely changed its facial expression. Nelson (1973) showed in her examination of early vocabularies that children learn first the names of objects that they can operate on and that change and move. Thus a strong case can be made that functional relevance determines which word meanings children learn. However, it appears that the content of the meanings and the basis for generalizing to new instances is, even initially, static perceptual information. This becomes less surprising if one considers that perceptual information, particularly static perceptual information, may constitute the first conceptual system that the child knows well. Many investigators have emphasized that children base their word meaning on prior conceptual structures (e.g., H. Clark, 1973; Huttenlocher, 1974; Nelson, 1974). It seems likely that static

perceptual knowledge is the conceptual system that children understand earliest, and therefore rely on in their early word meanings.

Word Usage

Given that a child has a meaning representation for a word, how is that stored meaning manifested in speech? Clark's (1973) initial hypothesis concerning the processes by which children use their stored word meanings might be termed the transparency hypothesis: that children apply a word when the situation fits perfectly with their stored meaning of the word. For example, if a child called cows, sheep, and other animals doggies it could be inferred that the child's meaning of doggie was consistent with all those animals, so that doggie might have only the features "Animate, Four-legged." Overextension of a word thus implied underspecification of its meaning. Following Huttenlocher's (1974) suggestion that children may understand more about word meanings than their productions reveal, Thomson and Chapman (1975) tested two-year-old children and found that words overextended in production are not always overextended in comprehension. A child who spontaneously applied doggie to cows might, when asked, be able to correctly choose the doggie from a pair consisting of a dog and a cow. This lack of correspondence between comprehension and production has led to the abandonment of the transparency assumption. As E. Clark (1975) says in her restatement of the semantic feature hypothesis, we cannot assume that children always apply the entire meaning of a word in a situation; rather, it appears that children sometimes use a word when only part of its meaning applies. An example given by Bowerman (1976) is Eva's use of

the verb kick when one or more of three features of a prototypical kicking situation was present; a waving limb, a sudden sharp contact or an object propelled.

An interesting asymmetry between comprehension and production occurs in the use of the verb stir. I investigated the verbs stir, mix and beat, in a production task (in which children labeled actions performed by the experimenter) followed by a comprehension task (in which children were given a variety of implements and asked to act out various actions). In comprehension of stir, all subjects, from 4 years old through adulthood, were exceedingly precise: they almost invariably acted out stir as a slow-to-moderate rotary motion, using correct implements. In contrast, the actions young children performed for the comparable verbs mix and beat were quite variable, (although correct implements were used for mix, though not always for beat). Thus the action meaning of stir appears to be well-specified, even for young children, and in particular it is better specified than the action meanings of mix and beat. However, when labeling the experimenter's actions in the production task, these same children showed quite a different pattern. Stir was the word most frequently applied by the youngest children to all hand-mixing-type actions, regardless of the rate of motion (slow or fast) and of the shape of the spoon's trajectory (rotary or back-and-forth). Paradoxically, the verb most narrowly comprehended is the one most broadly produced. This is a rather striking example of non-transparency in children's word usages. My guess is that children often choose in production to extend words whose meanings they know well, rather than use words they are less sure of. This may apply particularly to verbs and other relational terms, whose meanings in general are broadly used.

Breadth of Usage

Most common verbs are used very broadly in adult speech. For example, we use the verb give to convey change of possession, but we also speak of giving someone a headache, a college education, a good talking-to, and so on. We can make time, space, love and war, among other things. The breadth of meaning commonly found among verbs is much greater than that of simple nouns. In particular, if we take the number of word senses listed in a dictionary as a rough measure of the breadth of usage of a word, the verbs learned earliest by children have greater breadth of usage than the nouns. Dictionary entries for the first five verbs acquired (on the average) by children in Nelson's (1973) study show a mean of 9 word senses; for the first five nouns, the mean number is 6.2 (Webster, 1961).

Because of the breadth of adult verb usage, children's extensions of verbs often pass unnoticed. For example, a child who learns the verb open in the context of opening a door can extend open to removing a box top, pushing a window up, and stretching the mouth, and still be correct within the adult use of the term. Indeed, adult patterns of verb use may be based on the same principle as children's. The word senses of a given verb are not random collections of meanings, but are in general related to one another often as metaphorical extensions. Like Eva Bowerman's extension of kick, the adult senses of a given verb tend to share elements of meaning in common with a central prototype. It is only when children stumble onto an extension that happens not to occur in adult parlance, such as "open (turn on) the television" (Bowerman, personal communication), that we notice their adventuresome behavior with verbs.

The greater extendability of verbs is probably a factor in the long time course of verb acquisition, for it means that a small number of verbs suffices to convey a large number of messages. The distinction between pivot class and open class was an early formulation of the phenomenon that a small class of predicates is used broadly while a large class of content words, mostly simple nouns, is used more specifically (Braine, 1963). Children are able to communicate quite effectively by combining a few predicates such as go and more with large numbers of specific referential terms. Thus, in addition to the greater difficulty of learning abstract verb meanings, another reason that verbs are slower to be acquired than nouns may be that having few verbs and many nouns, or more generally, few relations and many things, is a good communication strategy.

Conclusions

Implications for Theories of Acquisition of Meaning

Clark's (1973) semantic feature hypothesis, with its central postulate that word meanings are acquired componentially, makes two specific predictions: (1) word meanings should be learned in order of semantic complexity, and (2) early errors should be indicative of incomplete semantic representations. Clark further hypothesized that the content of early word meaning is predominantly perceptual. Finally, a subsidiary assumption was that word use is transparent: i.e., that words are used in strict accordance with their meanings. If the notion of semantic features is extended to include the kinds of subpredicates that figure in verb meaning, the findings on acquisition of verbs agree remarkably well with the central tenets of the theory.

Both of the predicted lines of evidence have been found: Semantically simple verbs are learned before semantically complex verbs, and complex verbs are misapprehended in the early stages as meaning only part of what they mean to adults. Further, there is now a great deal of evidence for the contention that children's initial word meanings are based primarily on perceptual information, and that this contributes to the slowness with which verb meanings are learned. The only aspect of the original theory that seems to need serious revision is the transparency assumption. It appears that children make far more active use of their word meanings than was at first thought. Particularly where verbs are concerned, children (and adults) extend words to situations that only partially match their stored representations (cf. Clark, 1975).

Nelson's (1974) functionally based theory of meaning acquisition postulates an initial stage in the development of a word's meaning in which (1) relational and functional information predominate over perceptual information; and (2) the representation of the concept is holistic, not analytical; and (3) many functional relationships are stored, with superfluous ones being dropped later. These assumptions are not well supported by the research presented here. Considering the points in order, (1) both with the artificial objects of Experiments 1 and 2, and in the acquisition of the verb mix (Experiment 3) perceptual information preceded functional information in children's meanings; (2) in predicting acquisition patterns, the success of the componential treatment of verb meaning supports the notion that verb meanings are acquired and represented componentially, not holistically; and more specifically, (3) in acquisition of verb

meaning the typical pattern is one of gradual accretion of semantic components, rather than of initial storage of large numbers of components with later dropping-out of irrelevant components. Nelson's theory may apply better to children younger than those studied here. It may be that the children studied here had already learned rules for associating perceptual information with word meanings that were initially functional. However, the interpretation that best fits the present studies is that children's first word meanings are not functional but perceptual, and that the reason that the first verbs are acquired later than the first nouns is that children's initial hypotheses as to the nature of word meanings are inappropriate for verbs. Children must reformulate their approach to meaning before they can deal with the relational meanings of verbs.

Verbs and Nouns: A Reprise

The acquisition of verb meaning differs from the acquisition of of simple noun meaning in several ways. First, verb acquisition is a slower process. Verbs enter the vocabulary later than nouns and the rate of vocabulary increase in the first few years is lower for verbs than for nouns. Further, the meanings of many common verbs are not fully acquired until the age of 8 years or older. A second difference is that acquisition of verb meaning follows a more obvious pattern of accretion of components of meaning than does acquisition of simple noun meaning, (particularly since early noun overgeneralizations can no longer be taken as sufficient evidence for componential acquisition). Finally, verbs are more broadly used by children and by adults than are simple nouns.

These differences between verbs and simple nouns are traceable to differences between relational and referential meaning. Simple nouns can be seen as pointing to objects in the world. Perceptual information figures largely in their meanings, which are thus highly constrained by the nature of the world. In contrast, the meanings of verbs reflect the abstractions that enter into our notions of relatedness. Oversimplifying somewhat, one could say that the child has only to look at the world to discover simple noun concepts. The task of discovering which relationships are considered by the culture to be linguistically relevant is a more difficult one. As Bowerman (1976, p. 62) says, "...it is possible to imagine an almost infinite variety of ways in which particular children might come to regard some relationships between objects or events in their experiences as similar to other relationships..." Thus the relative abstractness and arbitrariness of and relational terms makes them slower to be acquired. Further, since the meaning structures of relational terms such as verbs are both less redundant and less densely interrelated than those of simple nouns, their components are acquired separately to a greater extent than are noun components. (This avenue awaits a more detailed representation of noun meaning than we now have).

The study of the acquisition of verbs and other relational terms offers a slow-motion glimpse into the child's implicit learning of the conceptual systems of the culture. In children's use of verbs we see from the very beginning a capacity for analogy and for creative extension. Gertrude Stein (1935) summed it up well:

Beside being able to be mistaken and to make mistakes verbs can change to look like themselves or to look like something else, they are, so to speak on the move and adverbs move with them and each of them find themselves not at all annoying but very often very much mistaken. That is the reason any one can like what verbs can do.

Footnotes

1. I am grateful to Bertram Bruce, Louis Carter-Saltzman, Allan Collins, Philip Dale, Veronica Dark, Elliot Saltzman and Erik Svehaug for their very helpful comments on earlier drafts of this paper. I also thank Wendy Baker, Lisa Buenaventura, Norman Dorpat, Nina Richardson, Erik Svehaug and Ilse Cline for their help with the research presented here, and Angela Beckwith for her help in preparing the manuscript.

2. This representational format was developed in a seminar headed by David E. Rumelhart and attended by Adele A. Abrahamson, Danielle Du Bois, Dedre Gentner, James A. Levin, and Stephen E. Palmer.

3. Both noun meaning and verb meaning can be considered referential, with nouns referring to thinglike elements and verbs referring to relational elements. Thus the contrast could have been described as "thing-referring" versus "relation-referring." However this description, in addition to being rather cumbersome, gives things and relations equal status as real-world entities, which I believe is not quite right, since the relations included in a semantic system reflect human conceptual choices to a greater extent than do the things. My choice of the terms "referential" versus "relational" perhaps overemphasizes the difference between things and relations. I believe this error will be more interesting than underemphasizing the difference.

   A similar (though not identical) distinction has been made by the philosophers Putnam (1975) and Kripke (1972), (see also

Fodor, 1977, pp. 209-214). They discuss a class of natural kind terms, which are defined by pointing to real-world objects, contrasting these with words that are defined analytically.

4. The argument can still be made, though with more difficulty, if the meaning of rose is considered to be a list of syntactically motivated features (e.g., + count, - animate, etc.).

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Table 1

Objects used in Experiment 1

	Name	Form	Use
Ojbect 1	jiggy	blue and yellow wooden box with large pink plastic face mounted on one side; small hole beneath face; lever on right side	sliding lever causes nose and eyes to move up and down, changing facial expression
Object 2	zimbo	gum-ball machine: clear plastic sphere, containing jelly beans mounted on red base with small hole; lever on right side	sliding lever causes jelly beans to fall from hole
Test Object		as for jiggy	as for zimbo

Table 2

Proportions of responses based on form ("jiggy" responses) in Experiment 1

Age Group (Years)	3-5	5-7	7-9	9-11	13-15	Adult
Proportion	.9	.42	.44	.33	.5	.75
(Number of Subjects)	(10)	(12)	(9)	(6)	(8)	(12)

Note: Proportions of responses based on use and proportions based on form sum to 1.

Table 3

Proportions of responses based on form in Experiment 2

	Age Group[a] (Years)	3-4	4-5	5-6	Adult
Noun		.63	.69	.5	.44
Verb		.56	.44	.44	.06

a. N = 8 children per group. There were 2 responses per child, for a total of 16 observations per proportion.

Table 4

Proportion of trials labeled by the action verbs *beat*, *stir*, and *shake* and by the function verb *mix* in Experiment 3

	BEAT, STIR or SHAKE[a]		MIX[b]	
Age in years	APPROPRIATE ACTION	INAPPROPRIATE ACTION	APPROPRIATE FUNCTION	INAPPROPRIATE FUNCTION
5-7	.97	.05	.48	.46
7-9	.93	.05	.67	.48
Adult	.81	.18	.69	.35

[a]Responses for *beat*, *stir* and *shake* are pooled over both substances. Proportions for appropriate uses of verbs are based on 32 possible uses (8 subjects X 2 substances X 2 trials); proportions for inappropriate uses are based on 64 uses (since on any trial there were two incorrect action-verb choices and only one correct choice.)

[b]Responses for *mix* are pooled over actions; *Mix* responses were counted as appropriate on trials with salt and water and inappropriate on trials with cream. Proportions are based on 48 possible uses (8 subjects X 3 actions X 2 trials).

Legends

1. Representation of "Ida gives Sam a rose."

   Abbreviations: A = agent
   E = experiences
   O = object
   R = recipient

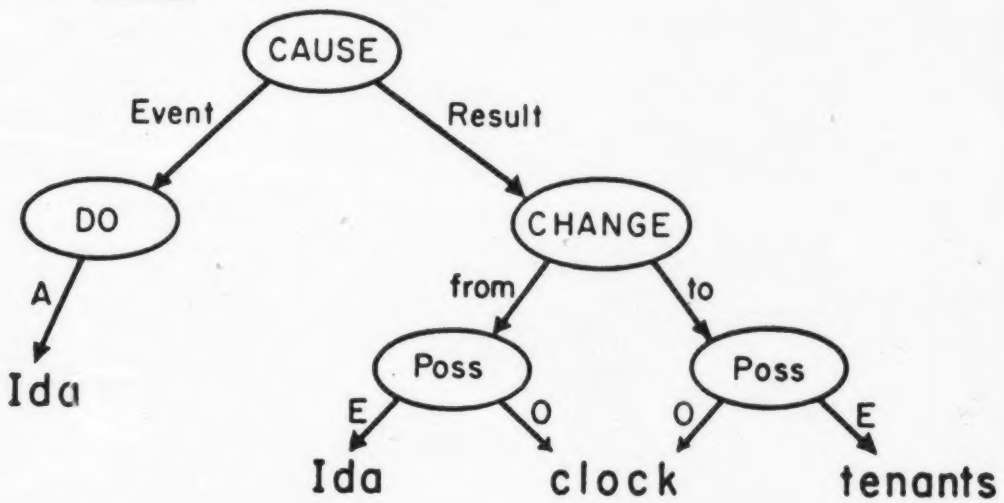
2. Representation of "Ida sells Sam a rose."

   Abbreviations: A = agent
   E = experiences
   O = object
   R = recipient
   Act = action

3. Representation of

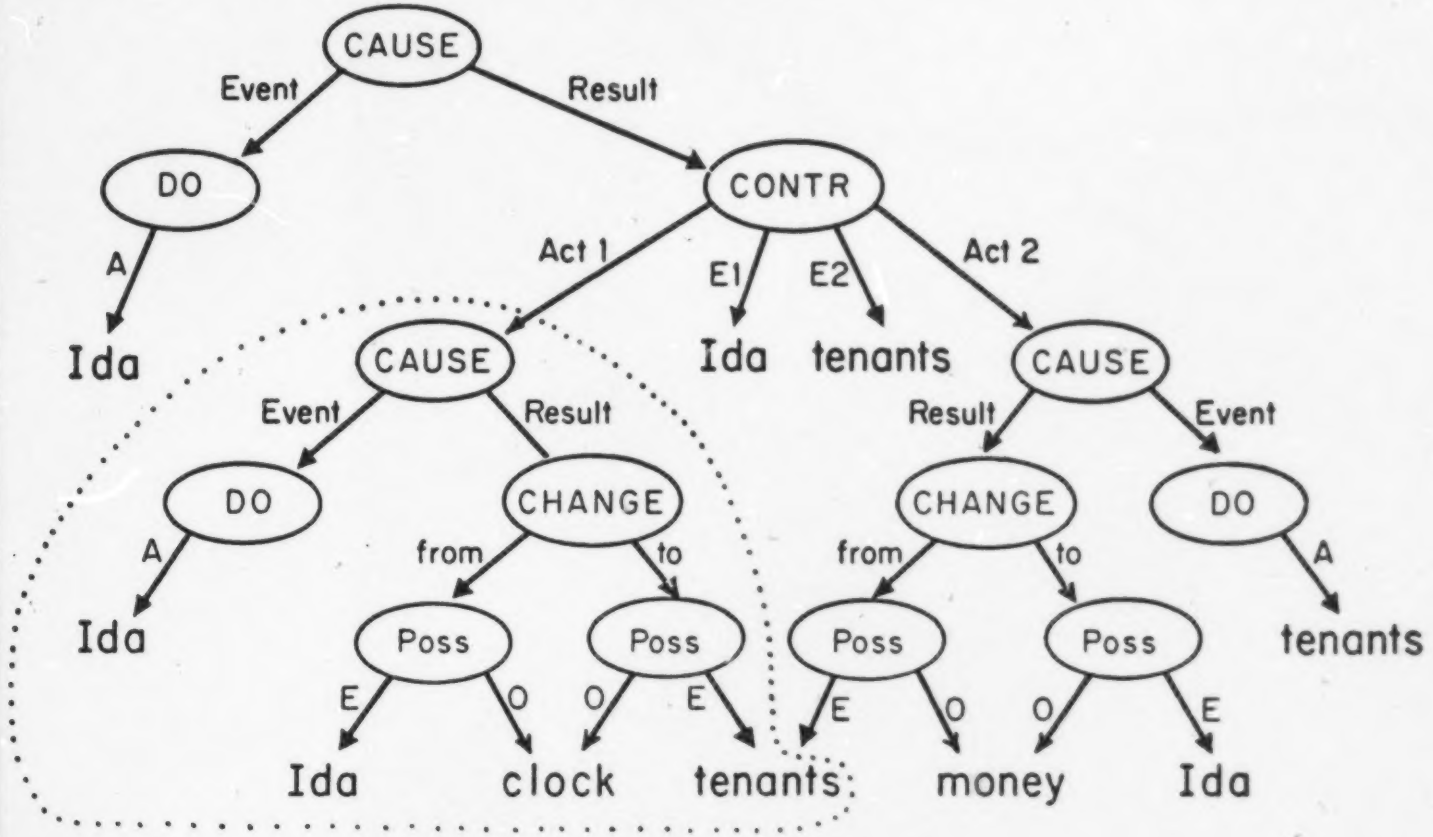
   a) "X mixes Y with instrument Z."
   b) "X stirs Y with instrument Z."

Ida gave her tenants a clock

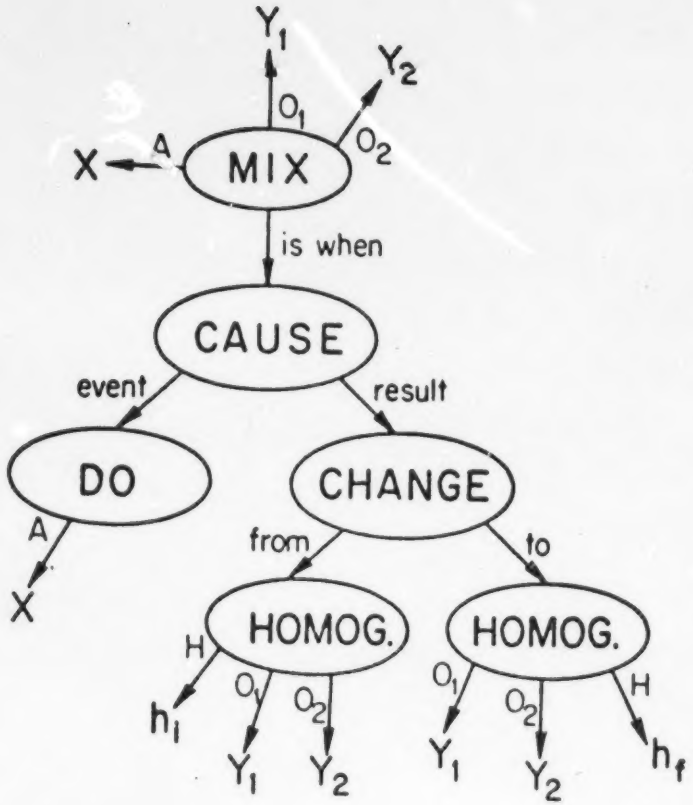


GENERAL VERB (FEW CONNECTING PATHS)

Ida sold her tenants a clock



SPECIFIC VERB (MANY CONNECTING PATHS)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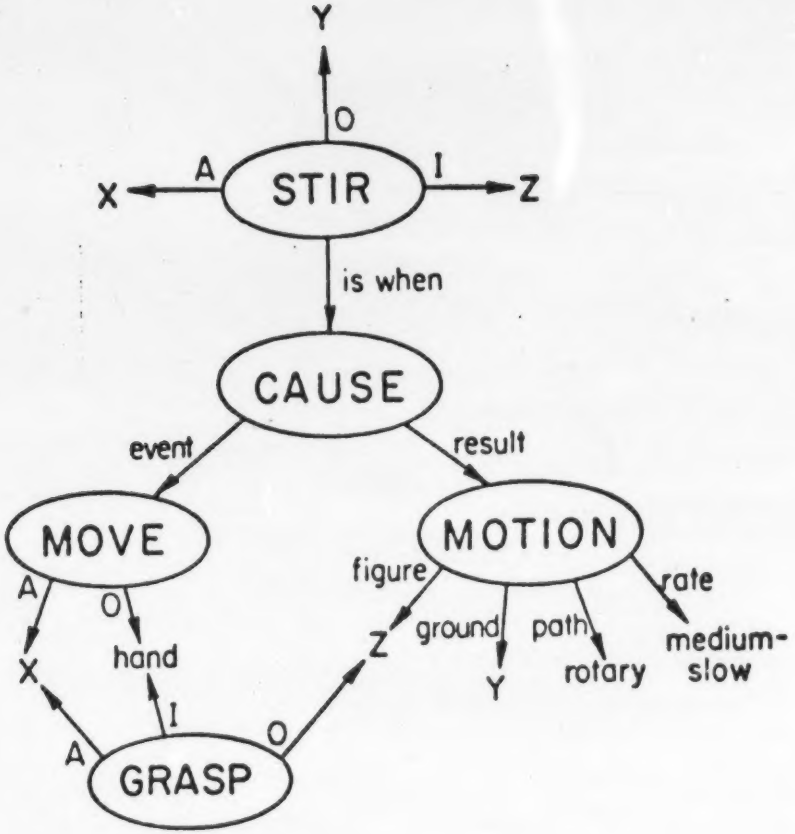
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